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(54) Title: METHOD AND APPARATUS FOR GENERATING RECOMMENDATION SCORES USING IMPLICIT AND EXPLICIT VIEWING PREFERENCE

(57) Abstract: A television programming recommender is disclosed that generates television program recommendations based on a combined implicit/explicit program recommendation score. The disclosed television programming recommender combines the explicit viewing preferences of viewers with their television viewing behavior (implicit preferences) to generate program recommendations. Explicit viewing preferences can be obtained by having viewers rate their preferences for various program attributes. The explicit viewing preferences are then utilized to generate an explicit recommendation score, E, for an upcoming television program. Implicit viewing preferences can be obtained by monitoring a user's viewing history and analyzing the programs that are actually watched by a user (positive examples) and the shows that are not watched by the user (negative examples). The implicit viewing preferences are then utilized to generate an implicit recommendation score, I, for an upcoming television program. A combined recommendation score, C, is computed based on the explicit and implicit scores, E and I. In one implementation, the combined recommendation score, C, can be computed using a weighted linear mapping.

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Method and apparatus for generating recommendation scores using implicit and explicit viewing preferences

The present invention relates to methods and apparatus for recommending television programming, and more particularly, to techniques for generating recommendation scores using implicit and explicit viewer preferences.

As the number of channels available to television viewers has increased, along with the diversity of the programming content available on such channels, it has become increasingly challenging for television viewers to identify television programs of interest. Historically, television viewers identified television programs of interest by analyzing printed television program guides. Typically, such printed television program guides contained grids listing the available television programs by time and date, channel and title. As the number of television programs has increased, it has become increasingly difficult to effectively identify desirable television programs using such printed guides.

More recently, television program guides have become available in an electronic format, often referred to as electronic program guides (EPGs). Like printed television program guides, EPGs contain grids listing the available television programs by time and date, channel and title. Some EPGs, however, allow television viewers to sort or search the available television programs in accordance with personalized preferences. In addition, EPGs allow for on-screen presentation of the available television programs.

While EPGs allow viewers to identify desirable programs more efficiently than conventional printed guides, they suffer from a number of limitations, which if overcome, could further enhance the ability of viewers to identify desirable programs. For example, many viewers have a particular preference towards, or bias against, certain categories of programming, such as action-based programs or sports programming. Thus, the viewer preferences can be applied to the EPG to obtain a set of recommended programs that may be of interest to a particular viewer.

Thus, a number of tools have been proposed or suggested for recommending television programming. The Tivo™ system, for example, commercially available from Tivo, Inc., of Sunnyvale, California, allows viewers to rate shows using a "Thumbs Up and

Thumbs Down" feature and thereby indicate programs that the viewer likes and dislikes, respectively. Thereafter, the TiVo receiver matches the recorded viewer preferences with received program data, such as an EPG, to make recommendations tailored to each viewer.

Implicit television program recommenders generate television program recommendations based on information derived from the viewing history of the viewer, in a non-obtrusive manner. FIG. 1 illustrates the generation of a viewer profile 140 using a conventional implicit television program recommender 160. The implicit viewer profile 140 is derived from a viewing history 125, indicating whether a given viewer liked or disliked each program. As shown in FIG. 1, the implicit television program recommender 160 processes the viewing history 125, in a known manner, to derive an implicit viewer profile 140 containing a set of inferred rules that characterize the preferences of the viewer. Thus, an implicit television program recommender 160 attempts to derive the viewing habits of the viewer based on the set of programs that the viewer liked or disliked.

Explicit television program recommenders, on the other hand, explicitly question viewers about their preferences for program attributes, such as title, genre, actors, channel and date/time, to derive viewer profiles and generate recommendations. FIG. 2 illustrates the generation of a viewer profile 240 using a conventional explicit television program recommender 260. The explicit viewer profile 140 is generated from a viewer survey 225 that provides a rating for each program attribute, for example, on a numerical scale that is mapped to various levels of interest between "hates" and "loves," indicating whether a given viewer liked or disliked each program. As shown in FIG. 2, the explicit television program recommender 260 processes the viewer survey 125, in a known manner, to generate an explicit viewer profile 240 containing a set of rules that implement the preferences of the viewer.

While such television program recommenders identify programs that are likely of interest to a given viewer, they suffer from a number of limitations, which if overcome, could further improve the quality of the generated program recommendations. For example, explicit television program recommenders typically do not adapt to the evolving preferences of a viewer. Rather, the generated program recommendations are based on the static survey responses. In addition, to be comprehensive, explicit television program recommenders require each user to respond to a very detailed survey. For example, assuming there are 180 different possible values for the "genre" attribute, and the user merely specifies his or her "favorite five genres," then no information is obtained about the user's preferences for the other 175 possible genres. Similarly, implicit television program recommenders often make

improper assumptions about the viewing habits of a viewer that could have easily been identified explicitly by the viewer.

A need therefore exists for a method and apparatus for generating program recommendations based on implicit and explicit viewing preferences. A further need exists for a method and apparatus for generating program recommendations that is program attribute or feature specific.

Generally, a television programming recommender is disclosed that generates television program recommendations based on a combined implicit/explicit program recommendation score. Thus, the disclosed television programming recommender combines the explicit viewing preferences of viewers with their television viewing behavior (implicit preferences) to generate program recommendations.

Explicit viewing preferences are obtained, for example, by having viewers rate their preferences for various program attributes, including, for example, days and viewing times, channels, actors, and categories (genres) of television programs. The explicit viewing preferences are then utilized to generate an explicit recommendation score, E, for an upcoming television program.

Likewise, implicit viewing preferences are obtained, for example, by monitoring a user's viewing history and analyzing the programs that are actually watched by a user (positive examples) and the shows that are not watched by the user (negative examples). The implicit viewing preferences are then utilized to generate an implicit recommendation score, I, for an upcoming television program.

The present invention computes a combined recommendation score, C, based on the explicit and implicit scores, E and I. In one implementation, the combined recommendation score, C, can be computed using a weighted linear mapping. The combined recommendation score, C, can optionally be biased towards the explicit recommendation score, E, since the explicit recommendation score, E, represents the interests that the viewer has explicitly specified.

A more complete understanding of the present invention, as well as further features and advantages of the present invention, will be obtained by reference to the following detailed description and drawings.

FIG. 1 illustrates the generation of an implicit profile using a conventional implicit television program recommender;

FIG. 2 illustrates the generation of an explicit profile using a conventional explicit television program recommender;

FIG. 3 is a schematic block diagram of a television program recommender in accordance with the present invention;

FIG. 4 is a table illustrating an exemplary explicit viewer profile;

FIG. 5 is a table illustrating an exemplary implicit viewer profile; and

FIG. 6 is a flow chart describing the program recommendation generation process of FIG. 3 embodying principles of the present invention.

FIG. 3 illustrates a television programming recommender 300 in accordance with the present invention. As shown in FIG. 3, the television programming recommender 300 evaluates each of the programs in an electronic programming guide (EPG) 310 to identify programs of interest to a particular viewer. The set of recommended programs can be presented to the viewer, for example, using a set-top terminal/television (not shown) using well-known on-screen presentation techniques.

According to one feature of the present invention, the television programming recommender 300 generates television program recommendations based on a combined implicit/explicit program recommendation score. Thus, the present invention combines the explicit viewing preferences of viewers with their television viewing behavior (implicit preferences) to generate program recommendations. Generally, each viewer initially rates their preferences for various program attributes, including, for example, days and viewing times, channels, actors, and categories (genres) of television programs.

As shown in FIG. 3, an explicit profile 400, discussed further below in conjunction with FIG. 4 and generated in a well-known and conventional manner, is utilized for each viewer. An explicit recommendation score, E, discussed below, is then generated for an upcoming television program indicated in the EPG 310. Likewise, an implicit profile 500, discussed further below in conjunction with FIG. 5 and generated in a well-known and conventional manner, is utilized for each viewer. An implicit recommendation score, I, discussed below, is also generated for an upcoming television program indicated in the EPG 310.

The present invention computes a combined recommendation score, C, based on E and I. In one implementation, the combined recommendation score, C, is biased towards the explicit recommendation score, E, since the explicit recommendation score, E, represents the interests that the viewer has explicitly specified.

Thus, as shown in FIG. 3, the television programming recommender 300 includes the explicit viewer profile 400, the implicit viewer profile 500, each discussed further below in conjunction with FIGS. 4 and 5, respectively, and a program recommendation generation process 600, discussed further below in conjunction with FIG. 6. Generally, the program recommendation generation process 600 processes the explicit and implicit viewer profiles 400, 500 and computes the combined recommendation score, C, in accordance with the present invention. It is noted that the numeric scales utilized in the explicit and implicit viewer profiles 400, 500 may not be the same, and the program recommendation generation process 600 may be required to convert one or both scales to a common representation.

The television program recommender 300 may be embodied as any computing device, such as a personal computer or workstation, that contains a processor 315, such as a central processing unit (CPU), and memory 320, such as RAM and ROM. In addition, the television programming recommender 300 may be embodied as any available television program recommender, such as the Tivo™ system, commercially available from Tivo, Inc., of Sunnyvale, California, or the television program recommenders described in United States Patent Application Serial No. 09/466,406, filed December 17, 1999, entitled "Method and Apparatus for Recommending Television Programming Using Decision Trees," (Attorney Docket No. 700772) and United States Patent Application Serial No. 09/498,271, filed Feb. 4, 2000, entitled "Bayesian TV Show Recommender," (Attorney Docket No. 700690), or any combination thereof, as modified herein to carry out the features and functions of the present invention.

FIG. 4 is a table illustrating an exemplary explicit viewer profile 400. As shown in FIG. 4, the explicit viewer profile 400 contains a plurality of records 405-413 each associated with a different program attribute. In addition, for each attribute set forth in column 440, the viewer profile 400 provides a numerical representation in column 450, indicating the relative level of interest of the viewer in the corresponding attribute. As discussed below, in the illustrative explicit viewer profile 400 set forth in FIG. 4, a numerical scale between 1 ("hate") and 7 ("love") is utilized. For example, the explicit viewer profile

400 set forth in FIG. 4 has numerical representations indicating that the user particularly enjoys programming on the Sports channel, as well as late afternoon programming.

In an exemplary embodiment, the numerical representation in the explicit viewer profile 400 includes an intensity scale such as:

Number	Description
1	Hates
2	Dislikes
3	Moderately negative
4	Neutral
5	Moderately positive
6	Likes
7	Loves

The explicit recommendation score, E, is generated based on the attribute values set forth in the explicit viewer profile 400. The explicit recommendation score, E, can be normalized, for example, to 1.0. The value of each weight factor could be determined empirically or by training a set of weights on the ground truth given by the particular viewer.

FIG. 5 is a table illustrating an exemplary implicit viewer profile 500 corresponding to the same viewer as the explicit viewer profile 400, discussed above. As shown in FIG. 5, the implicit viewer profile 500 contains a plurality of records 505-513 each associated with a different program attribute. In addition, for each attribute set forth in column 540, the implicit viewer profile 500 provides the corresponding positive and negative counts, in a known manner, in columns 545 and 550, respectively, indicating the number of times the viewer watched and did not watch, respectively, programs having each attribute. For each positive and negative program example (i.e., programs watched and not watched), a number of program attributes are classified in the user profile 500. For example, if a given viewer watched a given sports program ten times on Channel 2 in the late afternoon, then the positive counts associated with this features in the implicit viewer profile 500 would be incremented by 10, and the negative counts would be 0 (zero). Since the implicit viewing profile 500 is based on the user's viewing history, the data contained in the profile 500 is revised over time, as the viewing history grows.

FIG. 6 is a flow chart describing the program recommendation generation process 600 embodying principles of the present invention. The program recommendation

generation process 600 processes the explicit and implicit viewer profiles 400, 500 and computes the combined recommendation score, C, in accordance with the present invention.

As shown in FIG. 6, the program recommendation generation process 600 initially obtains the electronic program guide (EPG) 310 during step 610 for the time period of interest. Thereafter, the appropriate explicit and implicit viewer profiles 400, 500 are obtained for the viewer during step 615. The program recommendation generation process 600 then converts the numeric ratings for each attribute from the explicit or implicit viewer profiles 400, 500 to the same numeric scale, if necessary, during step 620.

The program recommendation generation process 600 obtains (or calculates) the explicit recommendation score, E, and the implicit recommendation score, I, for each program identified in the EPG 310 for the time period of interest during step 630. In one embodiment, the explicit recommendation score, E, is provided by a conventional explicit television programming recommender and the implicit recommendation score, I, is provided by a conventional implicit television programming recommender. In an alternate embodiment, the program recommendation generation process 600 can directly calculate the implicit recommendation score, I, in the manner described in United States Patent Application Serial No. 09/466,406, filed December 17, 1999, entitled "Method and Apparatus for Recommending Television Programming Using Decision Trees," (Attorney Docket No. 700772) or United States Patent Application Serial No. 09/498,271, filed Feb. 4, 2000, entitled "Bayesian TV Show Recommender," (Attorney Docket No. 700690), each assigned to the assignee of the present invention and incorporated by reference herein.

The program recommendation generation process 600 then calculates the combined recommendation score, C, for each program during step 640. In an illustrative implementation, the program recommendation generation process 600 calculates the combined recommendation score, C, in two parts, with a score based purely on the explicit profile of the user being computed in a first part and then combining the explicit and implicit recommendation scores to give a total combined score, C for a program.

Each show is characterized by a show vector, S, that provides a value for each attribute, such as < day/time (dt) slot, channel (ch), genres [1..k], description>. In an explicit profile 500, viewers typically only rate the day/time slot, channel and genres. Thus, only those features are maintained in the show vector, S. Thus, the show vector, S, becomes <dt, ch, g1, g2,..gK>.

A rating can be found for each of these features in S, in the user's explicit profile 500. Therefore, a rating vector is associated with each S, called R:

$R = < r_dt, r_ch, r1, r2, ...rK >$

The explicit recommender score, E, is computed as a function of R. Thus,

$E = f(R)$

The ratings [1..7] are mapped on a [-1..1] scale. A polynomial can be defined that satisfies certain boundary conditions, such as R equals 1 maps to -1, R equals 4 maps to 0, and R equals 7 maps to +1.

Once the mapping polynomial is defined, E can be defined as a weighted average of the individual ratings of the program's features. Let W_dt, W_ch, W_g represent the weights for day/time slot, channel and genres, respectively. It is noted that in the illustrative embodiment, only one weight is defined for all the genres, implying individual genres will contribute equally and if there are K genres, each genre will weigh W_g/K.

$$E = W_dt \times r_dt + W_ch \times r_ch + (W_g/K) \times \sum_{j=1}^{k} r_j$$

It is noted, however, that each individual genre could have a different weight W_g_j. For example, it has been observed that the first genre in the list of genres assigned to a given program seems to be the primary classification for that program, and the successive genres in the list diminish in relevance to that program. To illustrate, assume a given program is classified as a "comedy" as its first genre, followed by "situation" and "family," in order, as additional genres. Thus, the genre "comedy" can be weighed more heavily than the genre "situation," which in turn weighs more heavily than the genre "family" in the final weighted score computation of E (explicit recommendation score), above.

Returning to the illustrative embodiment, where all genres are weighted equally, the numerical values are now determined for the weights, before the explicit program recommendation score, E, is computed. This can be done empirically, i.e., based on observation or it can be dictated by input from the features, which stand out from the user's profile.

After computing the explicit program recommendation score, E, the combined recommendation score, C, is computed for a program that is dependent on both scores, E (explicit) and I (implicit).

$C = g(E, I)$.

In one embodiment, the function, g(), could be a weighted linear mapping. Thus,

$$C = \{W_e * E + W_i * I\}/\{W_e + W_i\}$$

Where "W_e" and "W_i" are weights that specify how much E and I contribute to the total score. W_e and W_i can be computed based on the following observations:

- When, the implicit and explicit scores are roughly the same, W_e = W_i = 0.5 - equal weighting (or possibly a slight bias towards W_e)
- When E >> I, the explicit interests of the user dictate that the show is of interest to that person, while the implicit profile indicates that it is not. Assuming the explicit information is more precise, the combined score, C, should depend more heavily on E than I. Hence, W_e >> W_i.
- The case of E << I is similar to the above case. The combined score, C, should reflect more of E than I. Hence, again W_e >> W_i.

The above observations indicate that as the difference between the explicit and implicit scores increase, the explicit score, E, should be weight more heavily.

Finally, the combined recommendation scores, C, for each program in the time period of interest can be presented to the user during step 650, for example, using on-screen programming techniques, before program control terminates during step 660.

It is to be understood that the embodiments and variations shown and described herein are merely illustrative of the principles of this invention and that various modifications may be implemented by those skilled in the art without departing from the scope and spirit of the invention.

CLAIMS:

1. A method for recommending television programs, comprising the steps of:
- obtaining a list of one or more programs (310);
- obtaining an explicit recommendation score, E, for said one or more programs (310);
- obtaining an implicit recommendation score, I, for said one or more programs (310); and
- generating a combined recommendation score, C, based on said explicit recommendation score, E, and said implicit recommendation score, I.

2. The method of claim 1, wherein said list of one or more programs (310) is obtained from an electronic program guide.

3. The method of claim 1, wherein said explicit recommendation score, E, is defined as a weighted average of individual ratings of program features.

4. The method of claim 1, wherein said combined recommendation score, C, is computed using a weighted linear mapping of said explicit recommendation score, E, and said implicit recommendation score, I.

5. The method of claim 1, wherein said combined recommendation score, C, is biased towards said explicit recommendation score, E.

6. The method of claim 1, further comprising the step of presenting said combined recommendation score, C, for each of said one or more programs (310) to a user.

7. A system (300) for obtaining a recommendation for a television program for a user, said program having attributes, comprising:
- a memory (320) for storing computer readable code; and
- a processor (315) operatively coupled to said memory (320), said processor (315) configured to:

- obtain a list of one or more programs (310);
- obtain an explicit recommendation score, E, for said one or more programs (310);
- obtain an implicit recommendation score, I, for said one or more programs (310); and
- generate a combined recommendation score, C, based on said explicit recommendation score, E, and said implicit recommendation score, I.

8. The system (300) of claim 7, wherein said list of one or more programs (310) is obtained from an electronic program guide.

9. The system (300) of claim 7, wherein said explicit recommendation score, E, is defined as a weighted average of individual ratings of program features.

10. The system (300) of claim 7, wherein said combined recommendation score, C, is computed using a weighted linear mapping of said explicit recommendation score, E, and said implicit recommendation score, I.

11. The system (300) of claim 7, wherein said combined recommendation score, C, is biased towards said explicit recommendation score, E.

12. The system (300) of claim 7, wherein said processor (315) is further configured to present said combined recommendation score, C, for each of said one or more programs (310) to a user.

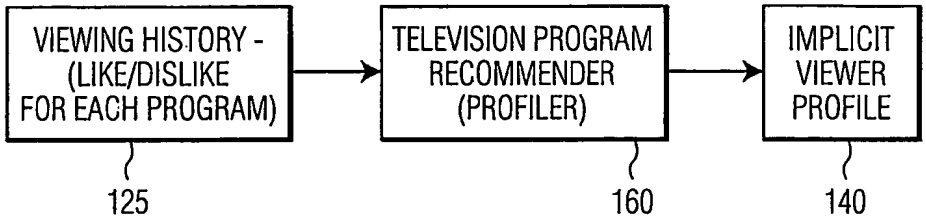

FIG. 1
PRIOR ART

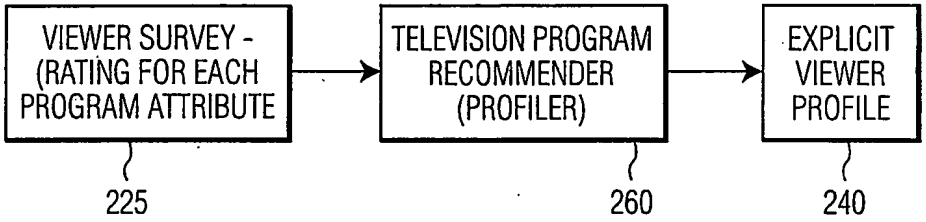

FIG. 2
PRIOR ART

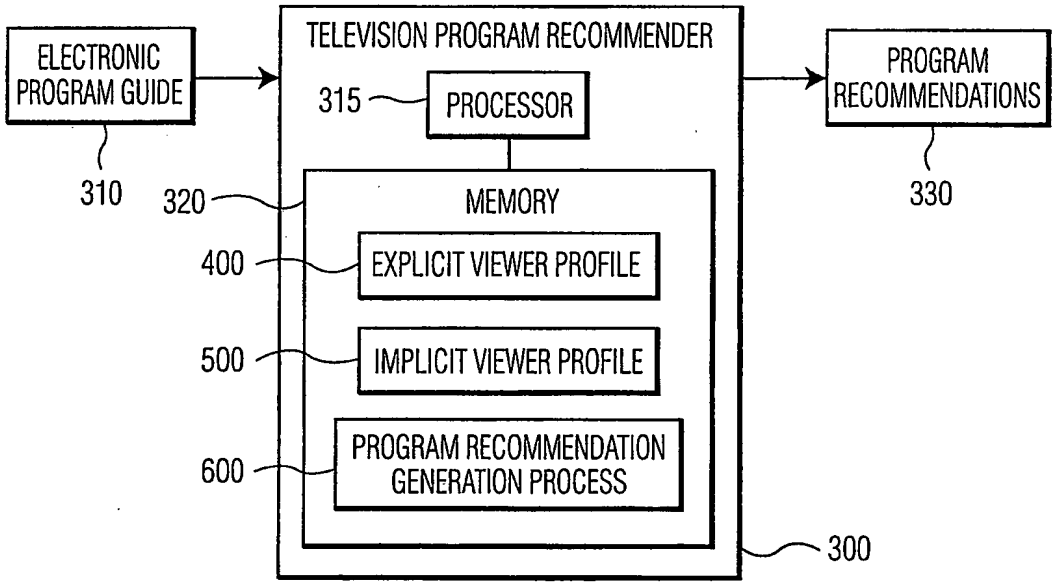

FIG. 3

EXPLICIT VIEWER PROFILE 400

	ATTRIBUTE 440	NUMERICAL (OR SYMBOLIC) REPRESENTATION 450
405	CHANNEL 2	3
406	CHANNEL 4	4
407	CHANNEL 7	3
408	•••	
409	SPORTS CHANNEL	7
•••	MUSIC CHANNEL	2
	•••	
410	MORNING PROGRAMS	1
411	EARLY AFTERNOON PROGRAMS	3
412	LATE AFTERNOON PROGRAMS	7
413	EVENING PROGRAMS	5
	•••	

FIG. 4

IMPLICIT VIEWER PROFILE 500

	ATTRIBUTE 540	POSITIVE COUNTS 545	NEGATIVE COUNTS 550
505	CHANNEL 2	10	0
506	CHANNEL 4	3	1
507	CHANNEL 7	4	4
	•••		
509	SPORTS CHANNEL	10	0
•••	MUSIC CHANNEL	1	0
	•••		
510	MORNING PROGRAMS	2	2
511	EARLY AFTERNOON PROGRAMS	1	2
512	LATE AFTERNOON PROGRAMS	10	0
513	EVENING PROGRAMS	6	4
	•••		

FIG. 5

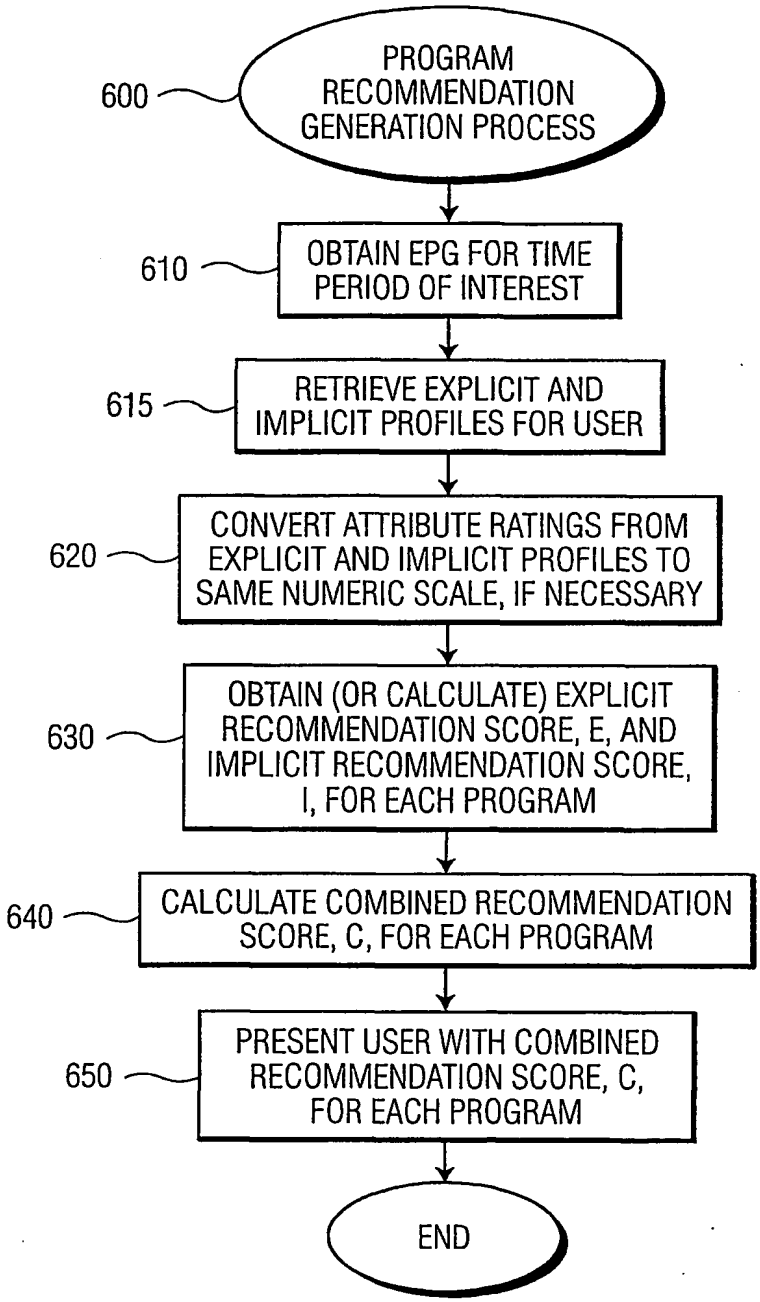
600
PROGRAM RECOMMENDATION GENERATION PROCESS
610
OBTAIN EPG FOR TIME PERIOD OF INTEREST
615
RETRIEVE EXPLICIT AND IMPLICIT PROFILES FOR USER
620
CONVERT ATTRIBUTE RATINGS FROM EXPLICIT AND IMPLICIT PROFILES TO SAME NUMERIC SCALE, IF NECESSARY
630
OBTAIN (OR CALCULATE) EXPLICIT RECOMMENDATION SCORE, E, AND IMPLICIT RECOMMENDATION SCORE, I, FOR EACH PROGRAM
640
CALCULATE COMBINED RECOMMENDATION SCORE, C, FOR EACH PROGRAM
650
PRESENT USER WITH COMBINED RECOMMENDATION SCORE, C, FOR EACH PROGRAM
END

FIG. 6